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BRIGHT MINDS,
BRIGHT LIGHTS.

Current and Future Trends of Miniaturized Optics in Vehicle Lighting



EPIC Technology Meeting on Photonics for Miniaturized Optics:
From Components to Use-cases at Sony DADC
Salzburg, 18.-19. September 2024

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ZKW Vision

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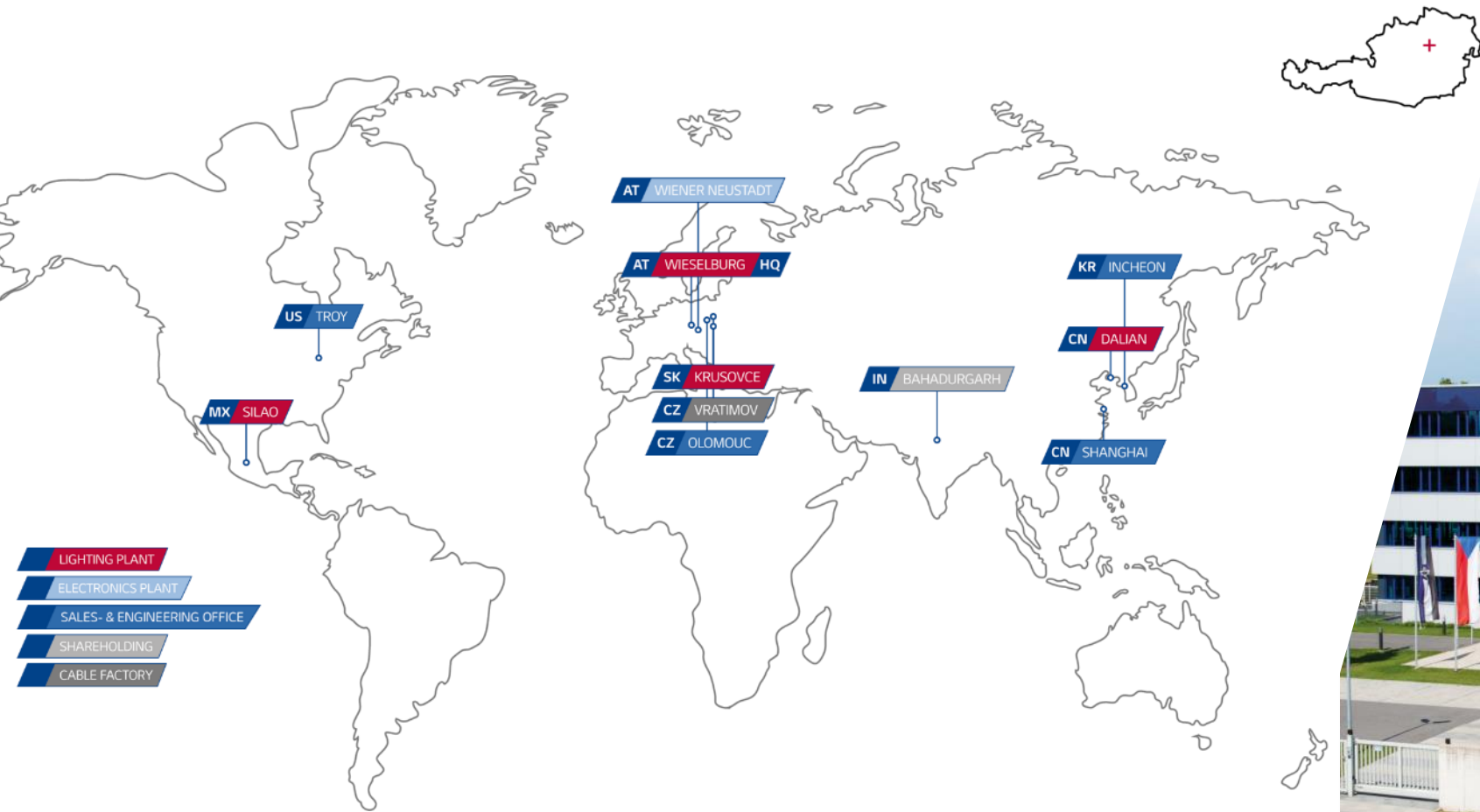
Pioneering premium lighting
and electronic systems by ZKW
for all mobility concepts
in the global automotive industry





Employees | Global Network

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- LIGHTING PLANT
- ELECTRONICS PLANT
- SALES- & ENGINEERING OFFICE
- SHAREHOLDING
- CABLE FACTORY



Headquarters Wieselburg, Austria





Modern Headlights



SIZE
ENERGY
DESIGN
COST





Miniaturized Optics in Vehicles

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4 examples will be discussed:

- > **Fresnel Optics**
- > **Surface Structuring**
- > **Diffractive Optical Elements (DOE)**
- > **Micro-Optical Lens Arrays (MLA)**



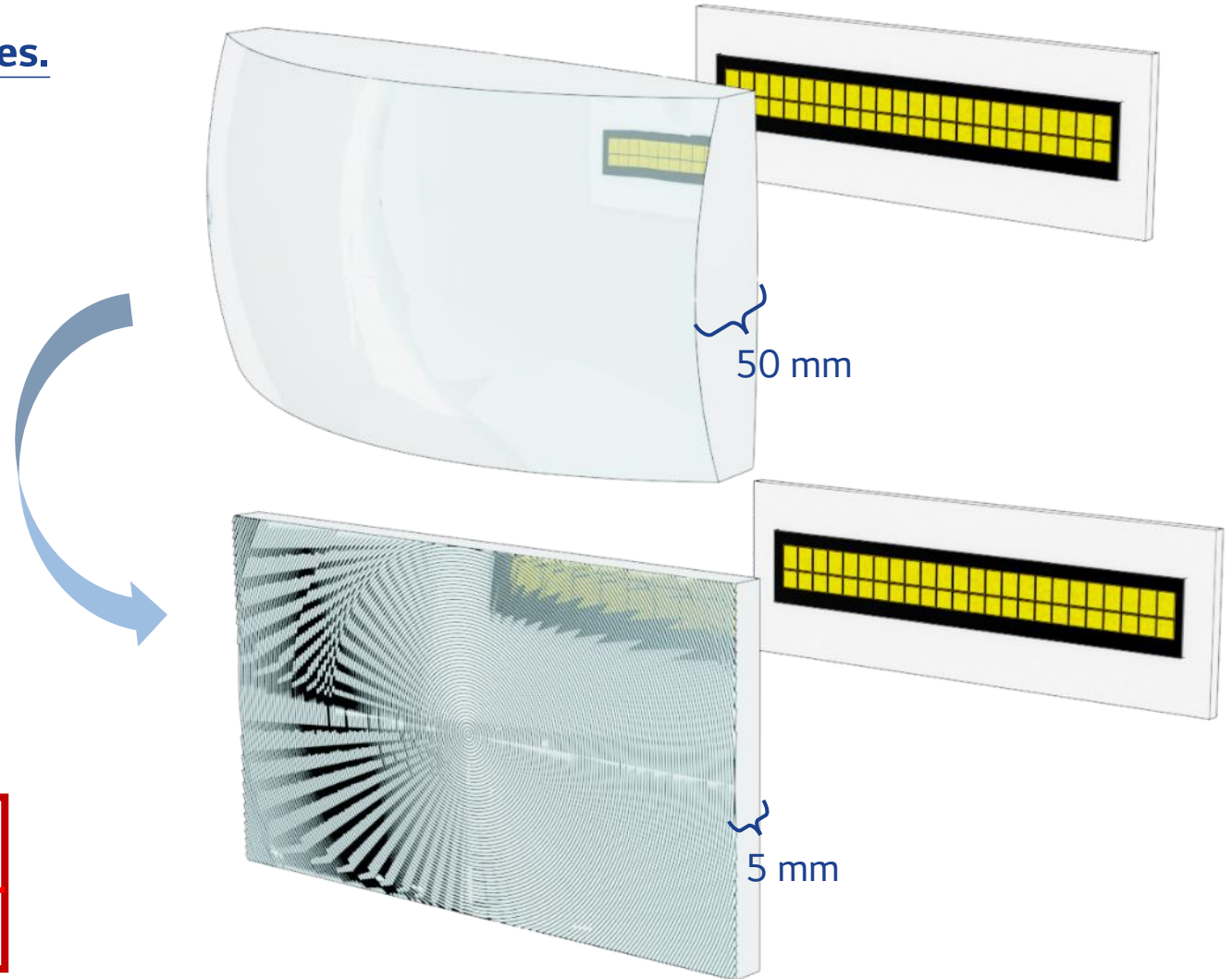
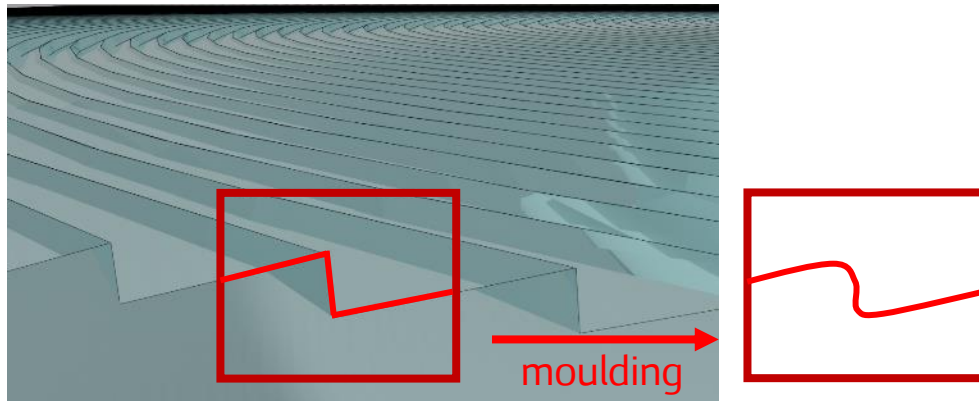
Application: compact cost-effective headlight modules.

Savings:

- + Material
- + Weight
- + CO₂

Challenges:

- Accuracy
- Straylight





Fresnel Optics

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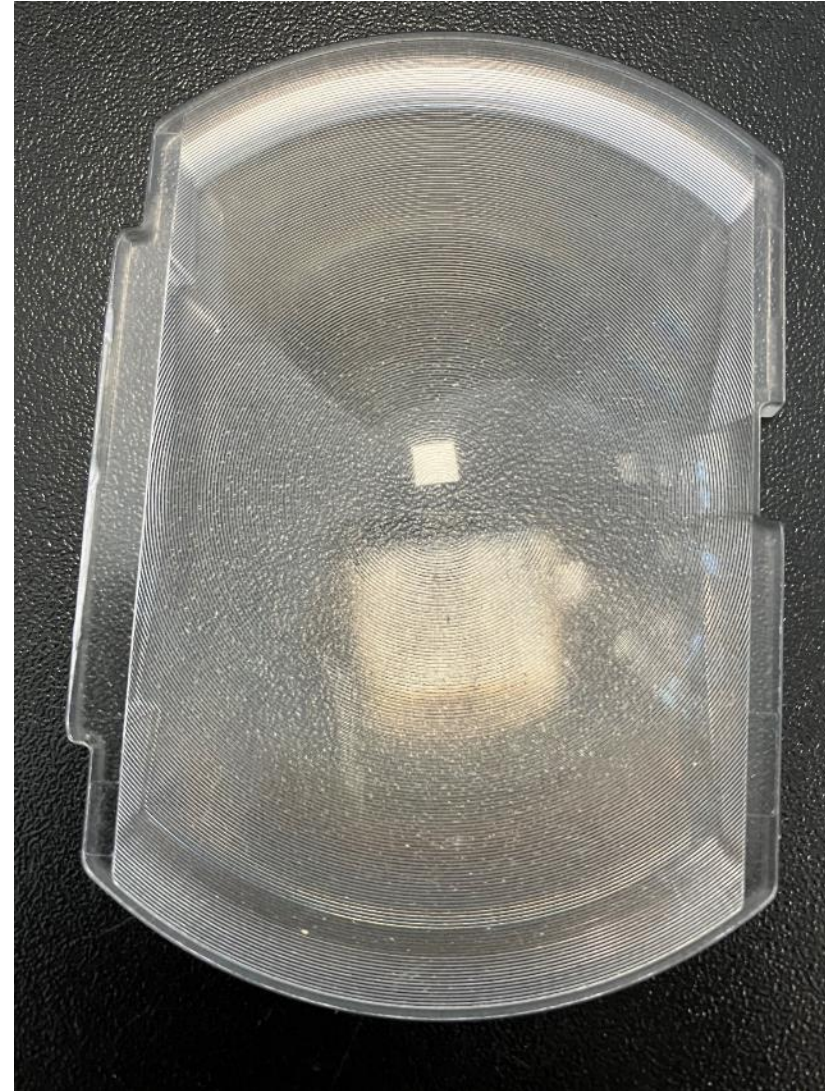
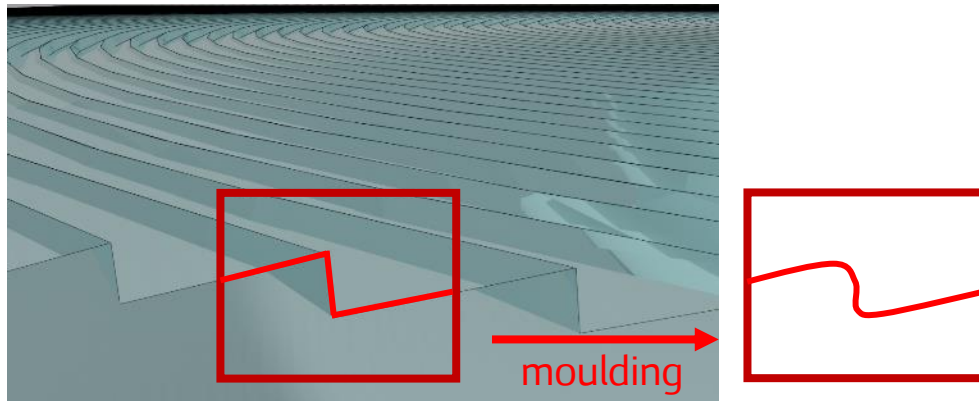
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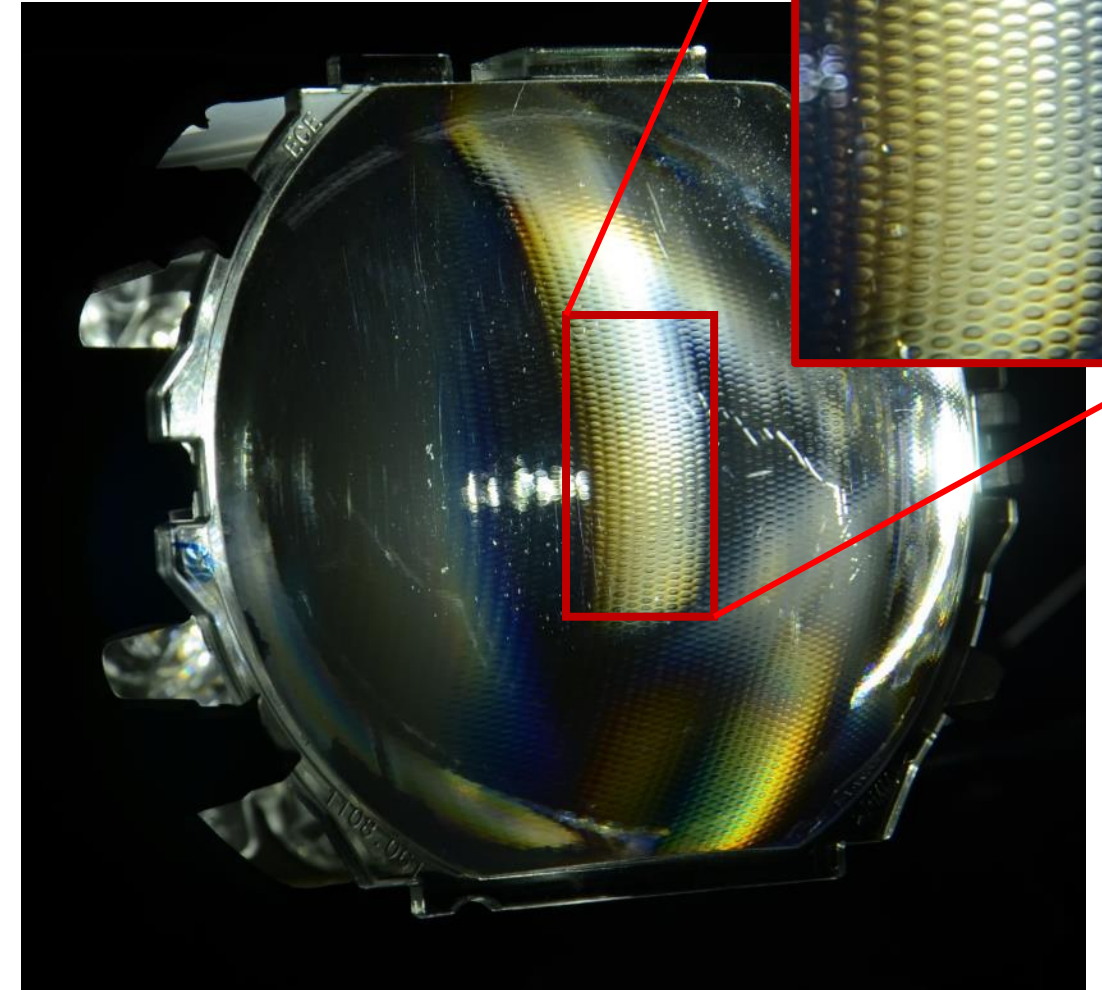
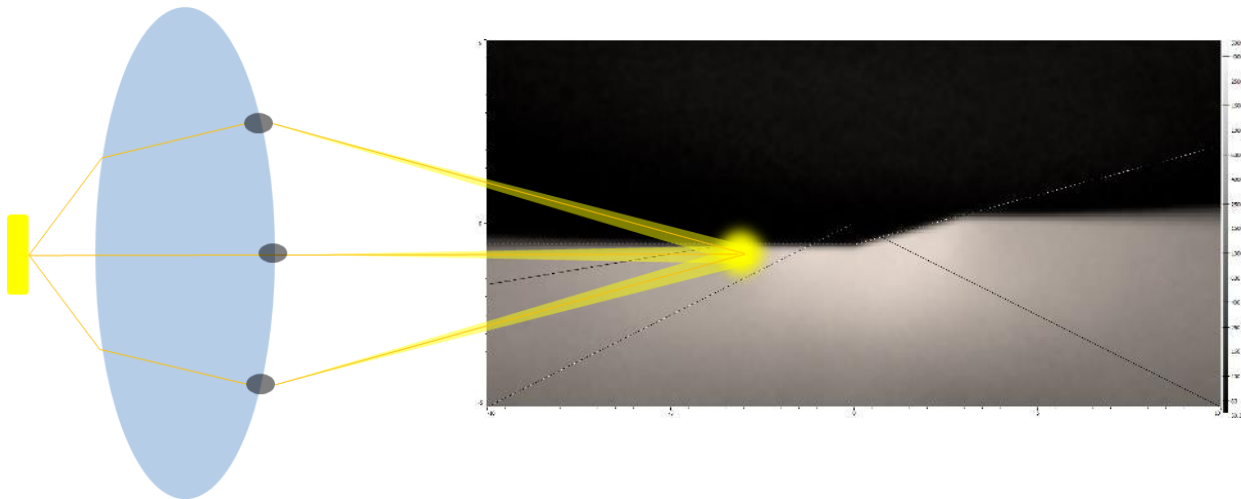
Surface Structuring

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Application: achieving homogenized beam patterns.

Idea:

- Structure on lens to smear out projected beam pattern
- Different types for different purpose





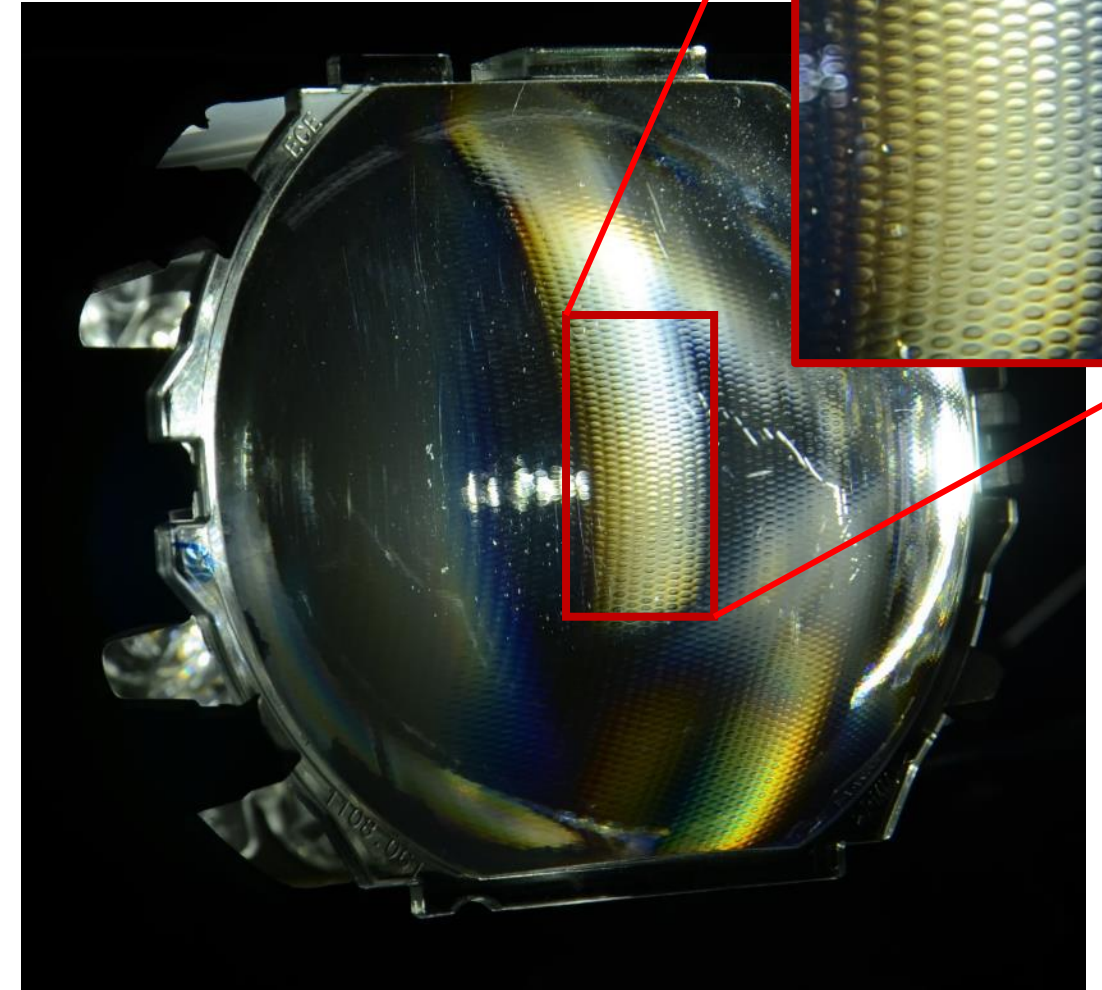
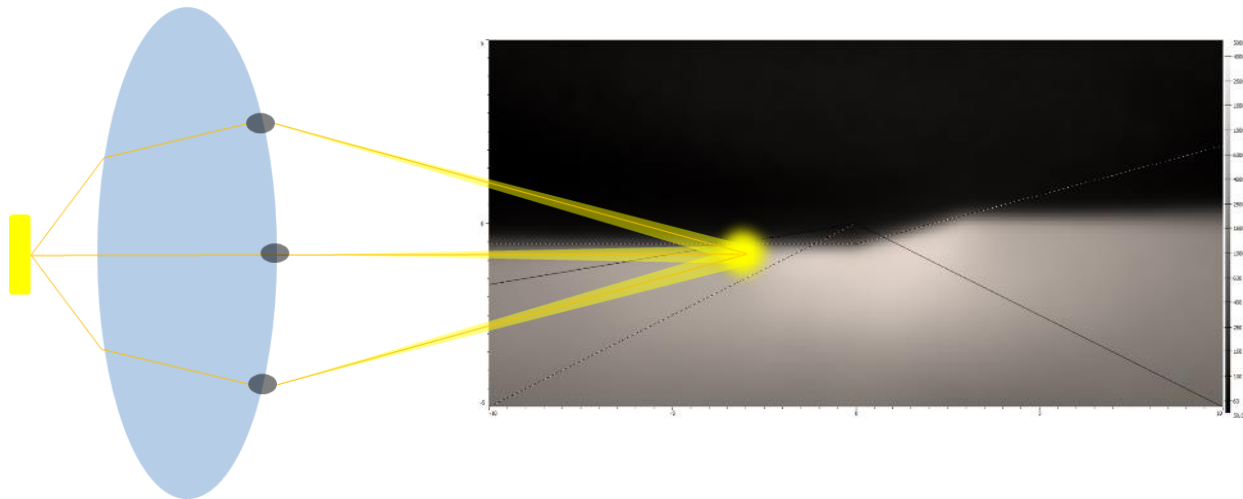
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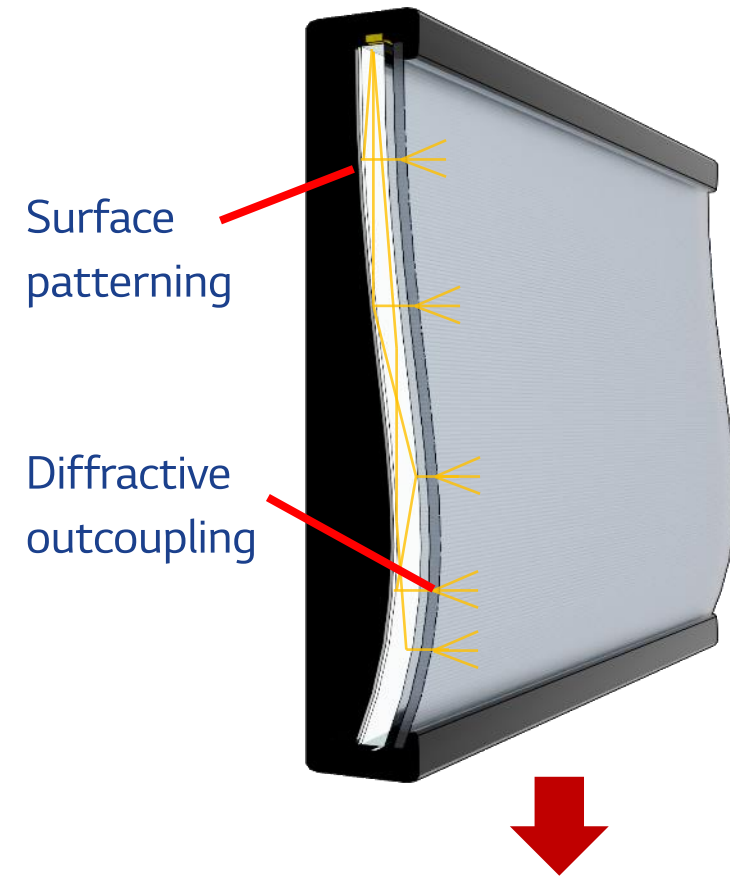
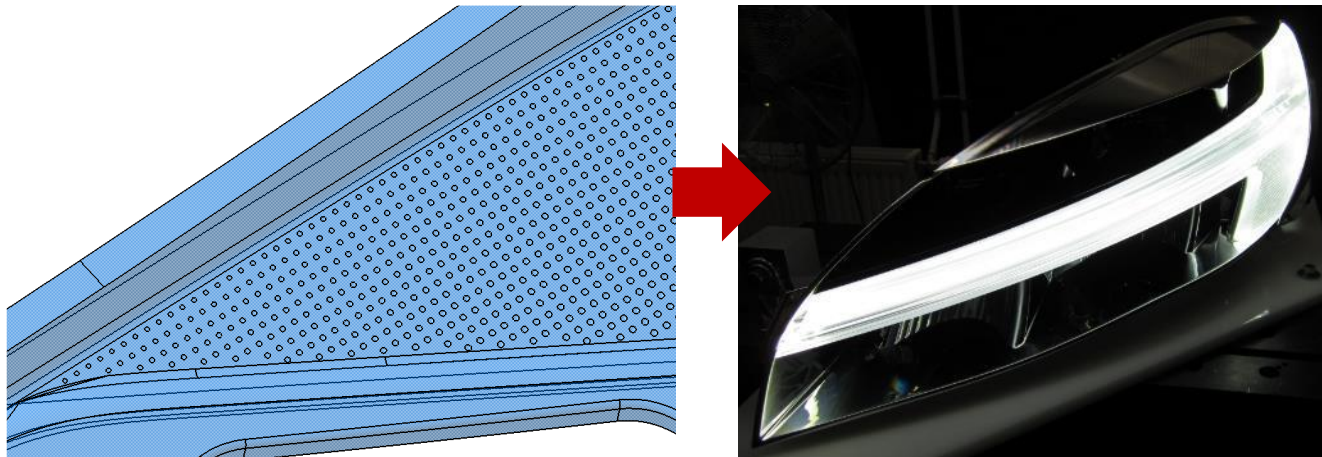
- Structure on lens to smear out projected beam pattern
- Different types for different purpose



Application: achieving homogenized beam patterns.

Idea:

- Structure on lens to smear out projected beam pattern
- Different types for different purpose
- Surface patterning for coupling light out of daytime running light



Application: projection modules.

Idea:

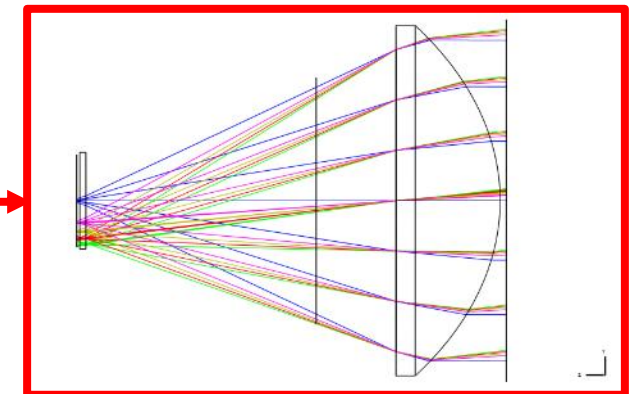
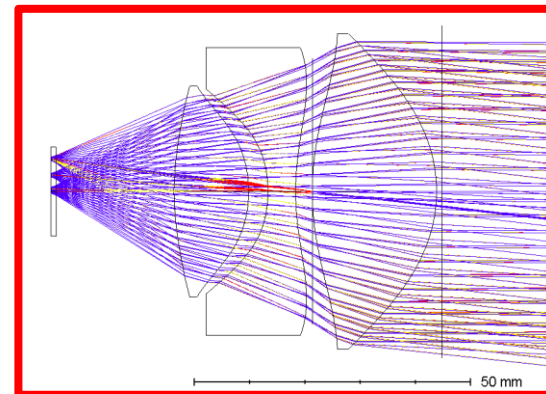
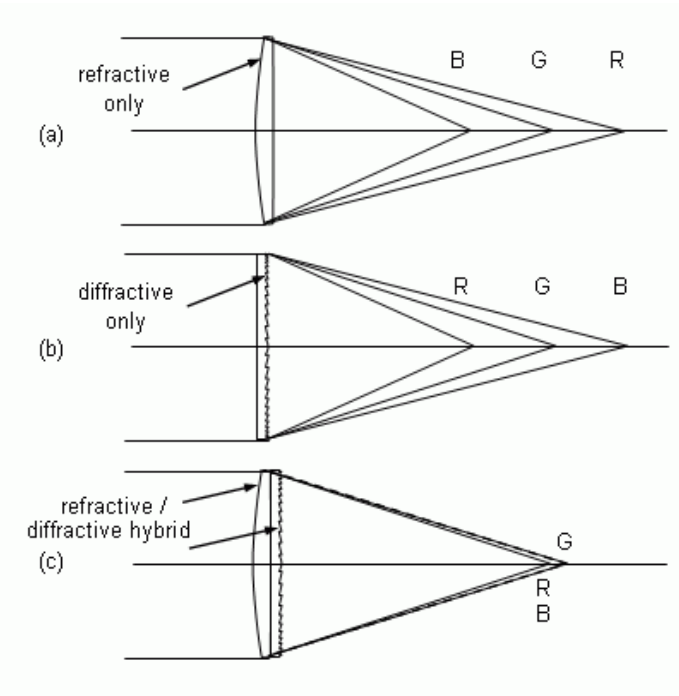
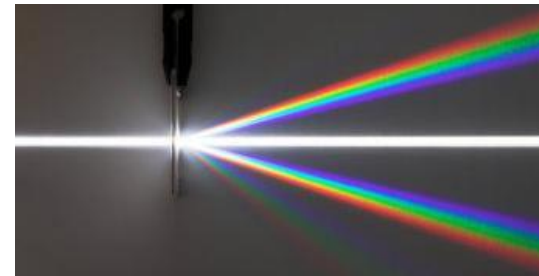
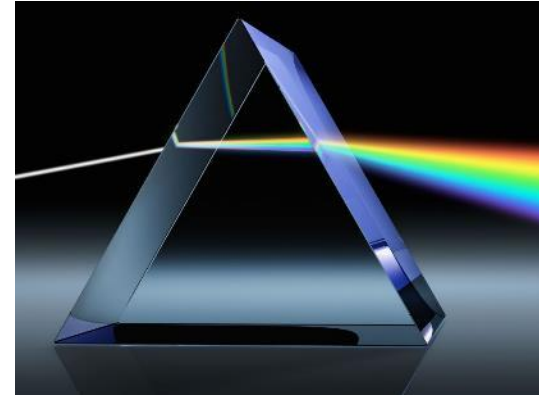
- Structures in the order of μm
- Lens surface multiplexing

Benefits:

- + Color correction
- + Lens surface multiplexing
- + Less parts \rightarrow less surface loss

Challenges:

- Molding accuracy
- Higher orders



Application: projection modules.

Idea:

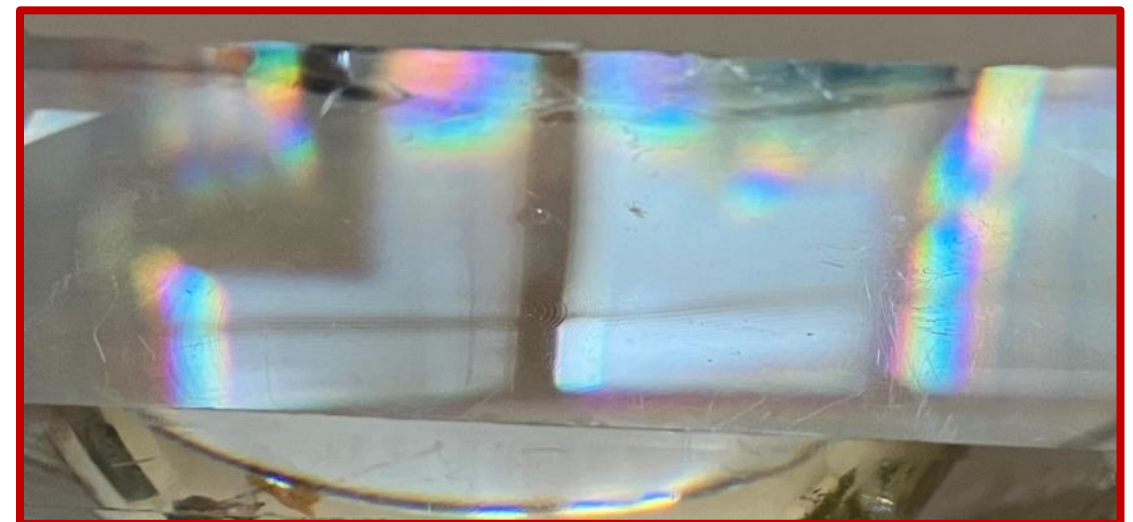
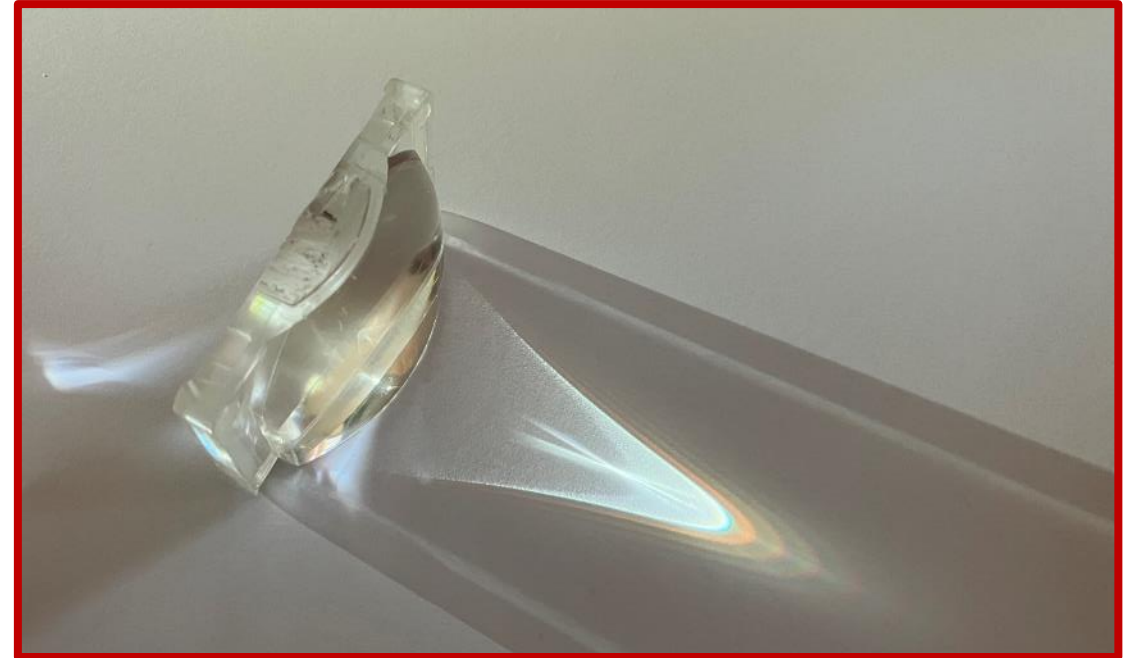
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Application: miniaturization of vehicle headlamp modules.

Idea:

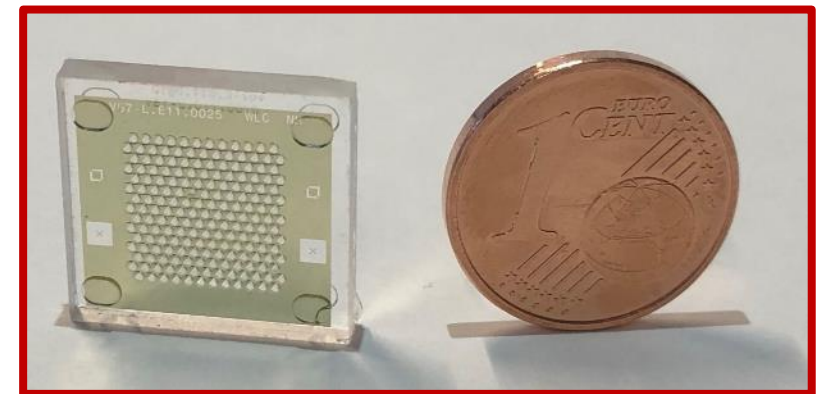
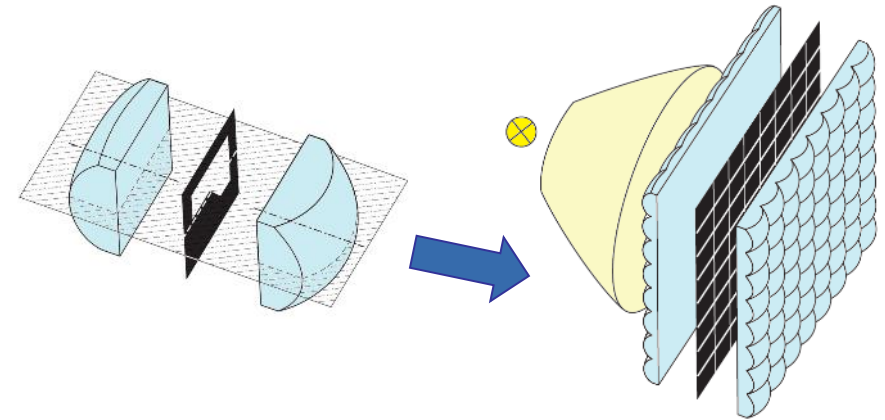
- Shrinking the length of common headlight modules by factor ~ 10
- Very design driven \rightarrow any shape

Benefits:

- + extremely small headlights
- + very homogeneous beams
- + any kind of projection (turn indicator, logo, driving beam)

Challenges:

- Cost





Micro-Optical Lens Arrays (MLA)

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Summary

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Fresnel Optics



ZKW development car



Summary

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Fresnel Optics

Surface Structuring



ZKW development car



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Fresnel Optics

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Diffractive Optical Elements (DOE)



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- ✓ Fresnel Optics
- ✓ Surface Structuring
- ✓ Diffractive Optical Elements (DOE)
- ✓ Micro-Optical Lens Arrays (MLA)



ZKW development car



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- ✓ Fresnel Optics
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Miniaturized optics everywhere!

We are open for any kind of collaborations!



ZKW development car



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BRIGHT LIGHTS.

**Thank you for your
attention!**



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